

Our topics:

- Conference participation
- Events
- Trainings
- Publications
- FX-Column

Newsletter – MathFinance AG

December 2024

Another busy year is turning final. No options left out. And the odyssey will continue.



The MathFinance team wishes everyone a happy holiday season.

1. CONFERENCE PARTICIPATION

Prof. Thorsten Schmidt

plenary speaker at this year's QMF in Sydney. He talked about his latest results regarding unit-linked insurance, the relation to actuarial valuation rules, uncertainty and the concept of insurance - finance arbitrage (introduced by Artzner et al. 2024).

Date: 17 - 20 December 2024

Venue: Quantitative Methods in Finance, University of Technology Sydney



Prof. Uwe Wystup

plenary speaker at the 2nd Abu Dhabi Research in Options Conference. He will talk about current industry models and applications of FX options in practice: who uses which instruments and what can go wrong

Date: 6 - 8 January 2025

Venue: Khalifa University, Abu Dhabi, Emirates

<https://ctl.ae/adrio2#/speakers?lang=en>



جامعة خليفة
Khalifa University

2. EVENTS

25th MathFinance Anniversary Conference

Save the Date: 18 + 19 September 2025

We shall reconvene at Burg Reichenstein on the Rhine River. Applications for contributed talks appreciated. Stay tuned.

Foto gallery of this year's conference:

<https://www.mathfinance.com/events/24th-mathfinance-conference/gallery/>

3. TRAININGS

Relaunch of three 2-day courses by Uwe Wystup:

- FX Advanced vanilla options
- FX structured products
- FX exotic options



<https://www.mathfinance.com/derivatives-training>

London Financial Studies will run the next course on FX Exotic Options with Prof. Uwe Wystup
30 June - 2 July 2025 (Central London and via video conference)

<https://www.londonfx.com/course/FX-Exotic-Options>

4. PUBLICATIONS

Expert Witness Institute (EWI): interview with Prof. Wystup

[Day in the Life of a Financial Expert](#)



Uwe Wystup's FX Column on how barriers brake the spot
in Wilmott, January 2025

<https://wilmott.com/wilmott-magazine-january-2025-issue/>

Uwe Wystups FX Column Worth a TRY? Zero-Cost, Zero-Risk, 20 M USD up strategy in USDTRY
in Wilmott, November 2024

<https://wilmott.com/wilmott-magazine-november-2024-issue/>

5. FX COLUMN

FX Column: Why are USD-JPY Risk Reversals always Negative?

Uwe Wystup, MathFinance AG, Frankfurt am Main

As a typical currency pair with a negative Risk Reversal, I always pick USD-JPY. Quite reliable. One might then wonder why USD-JPY Risk Reversals are always negative. Well, actually, that is not true. See the history in [Figure 1](#). But almost, with some short periods of exceptions. In this column I will explain the reason.

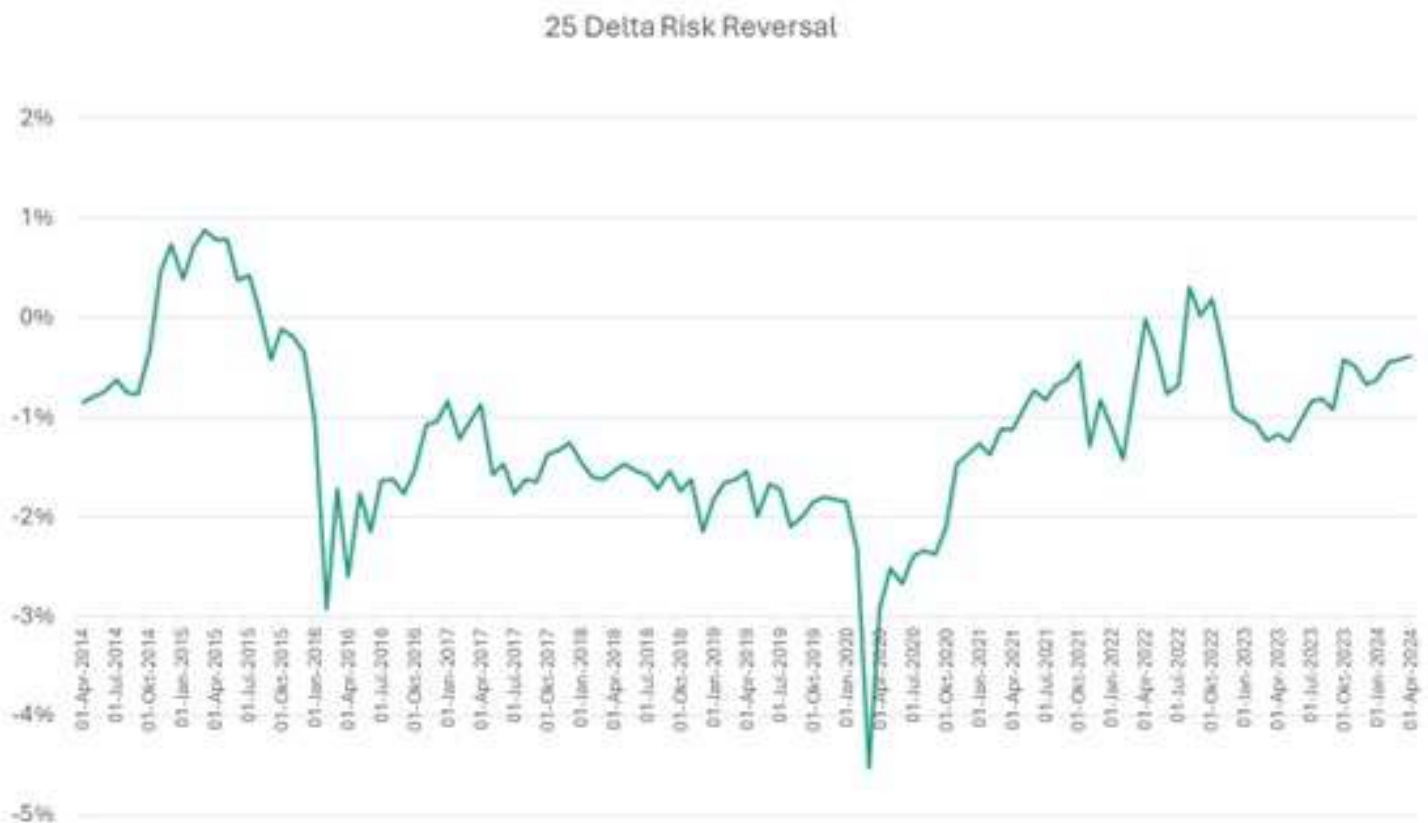


Figure 1: USD-JPY 1 Year 25 Delta Risk Reversal from 2014 to 2024. Source: Refinitiv

A negative risk reversal means that out-of-the money USD put JPY call options are priced at a higher volatility than USD call JPY put options: options with lower strike prices are more expensive than options with higher strike prices causing a down-skew as illustrated in [Figure 3](#).

Market Situation:

Interest rates in USD (currently 5.63% for year) are and have been higher than JPY interest rates (currently 0,22% for one year). This implies a forward backwardation in USD-JPY, as shown in [Figure 2](#). The forward

curve shown there are the FX forward rates on the y-axis as a function of the maturity time on the x-axis.

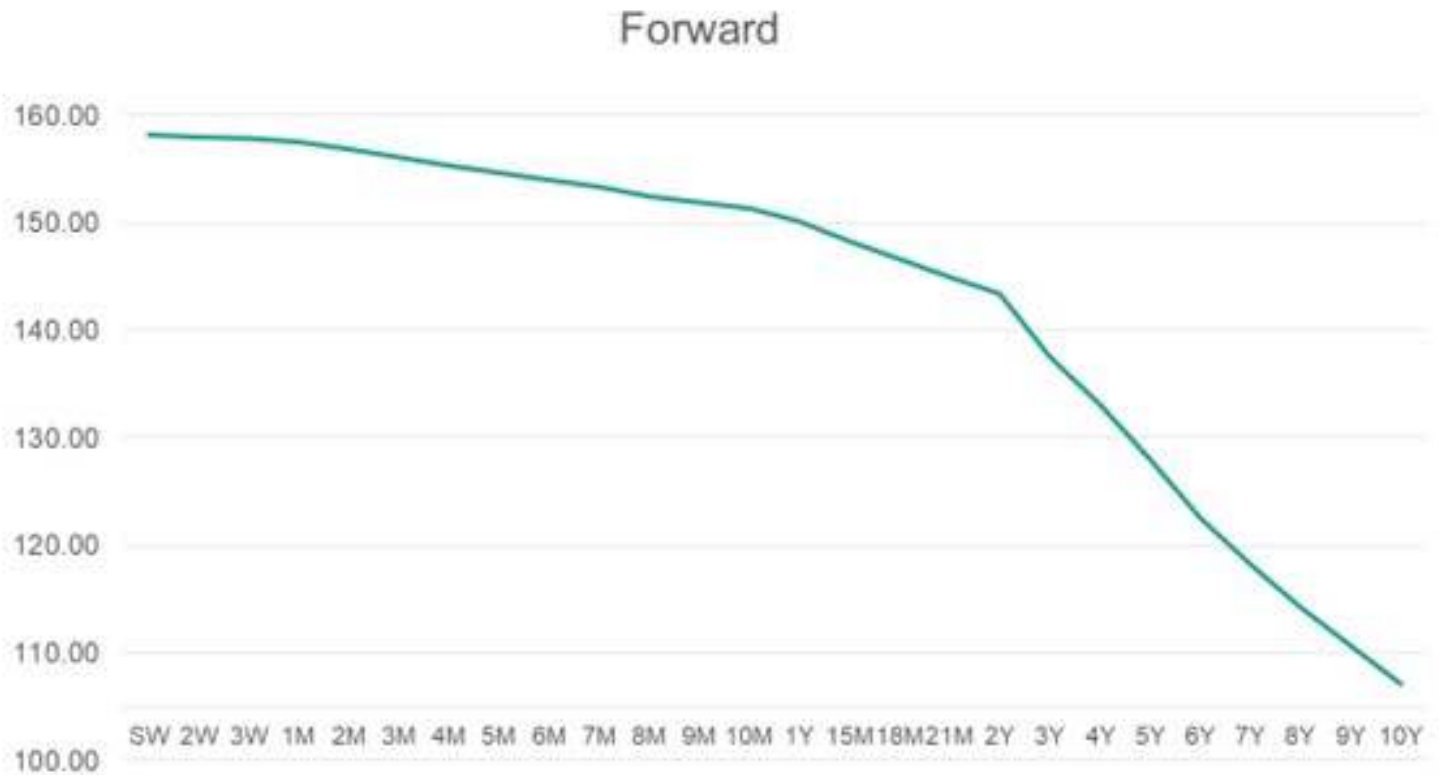


Figure 2: USD-JPY Forward Curve on April 28 April 2024. Source: Refinitiv

While the FX forward in USD-JPY points downwards, the expectation of the future spot is sideways or upwards for many market participants, see the historic USD-JPY spot in [Figure 4](#). Therefore, many investors including Mrs. Watanabe, the Japanese housewife, are tempted to engage in a carry trade, i.e. change JPY into USD, park the USD in a money market account, get a higher interest, and at maturity, change the USD back to JPY. This works well if USD-JPY forward is in backwardation and the spot rises.

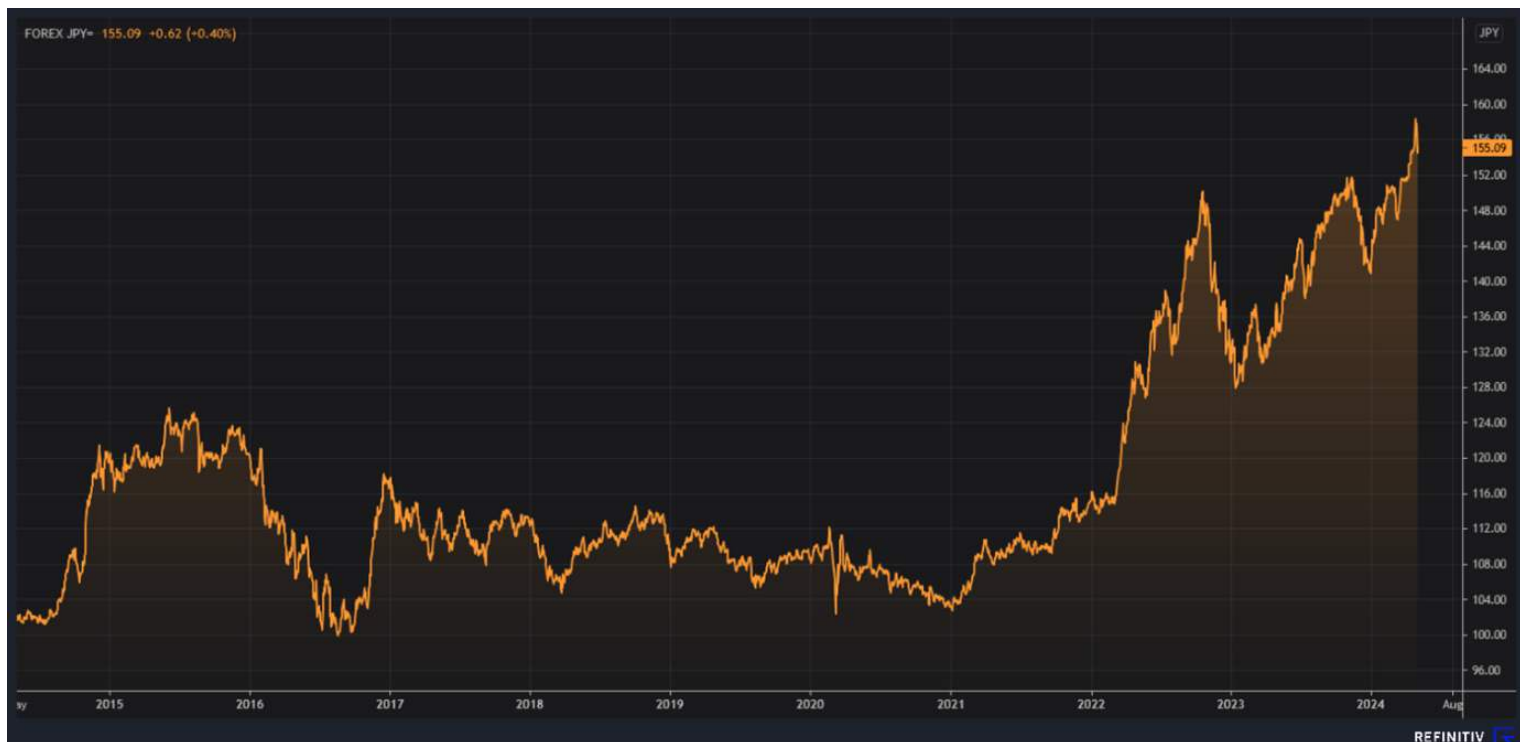


Figure 3: USD-JPY spot in 2014 to 2024. Source: Refinitiv EIKON

USD-JPY Smile

The 1-year smile curve in USD-JPY is illustrated in [Figure 4](#), based on ATM=10.03%, RR=-0.39% (in favor of OTM USD puts), BF=0.418%. To explain this rather persistent down-skew in USD-JPY, I need to take a detour into FX-linked structured products.

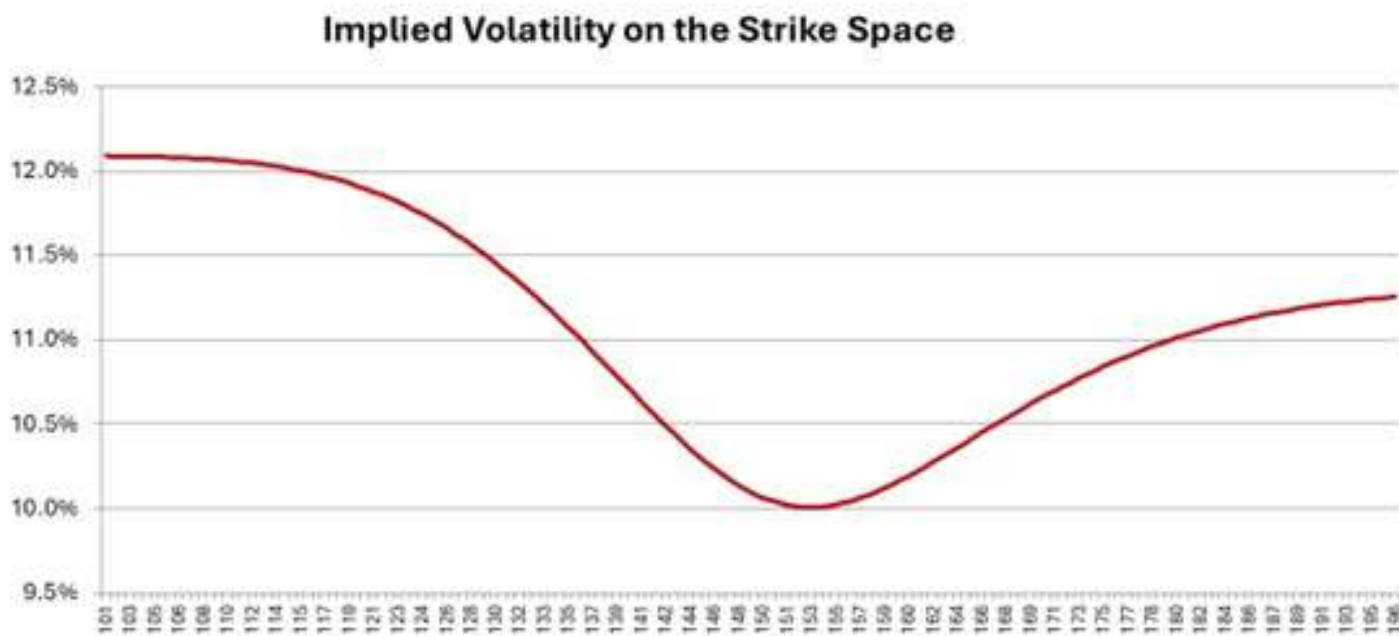


Figure 4: USD-JPY 1-Year Smile on 28 April 2024, Strikes on the x-axis, Implied Volatility on the y-axis. Source: Refinitiv

Impact of Power Reverse Dual Currency Bonds (PRDCs)

A PRDC is a generic name for an entire class of transactions (bonds and swaps), whose coupons depend on an exchange rate or are quantoed into other currencies, and/or whose notionals may be converted into other currencies. The reason PRDCs came up was the low interest environment in Japan along with the pension funds in Japan that had promised high yields to their investors. Now how to boost the coupons? It is well-known that generating returns is normally done via carry trades or selling options or selling option-like features (callability). Essentially, all these approaches tend to increase the risk of the investor. The risk has been amplified further, because practically all pension funds ended up having the same positions.

Trade Features

We start with a very common example of a long dated (typically 20Y to 30Y) dual currency trade in USD and JPY, in the format of a swap:

1. Principal exchange of USD 1 M against JPY 115 M at inception (e.g. in November 2014)
2. Financing (funding) coupons depending on LIBOR, e.g. 6M JPY-LIBOR
3. Power (structured) coupon depending on FX rate, e.g. USD-JPY
4. Reverse principal exchange of JPY 115 M against USD 1 M at maturity

The power coupon depends on the FX rate. As a simple example we consider a call spread power coupon

$$N \times \min (\max(F \times S_T / S_0 + M, \text{Floor}), \text{Cap}),$$

where N denotes the notional, F the fixed rate, M the margin, S_0 the initial spot rate, S_T the spot rate at the coupon fixing date, and T the tenor. For example, with an initial spot of $S_0 = 120$ in USD-JPY, the payoff power coupon

$$N \times \min (\max(24\% \times S_T / 120 - 18\%, 0\%), 6\%)$$

represents a call spread with coupon of 0% for USD-JPY spot below 90.00, 6% for USD-JPY spot above 120.00 and linear interpolation in between, see [Figure 5](#).

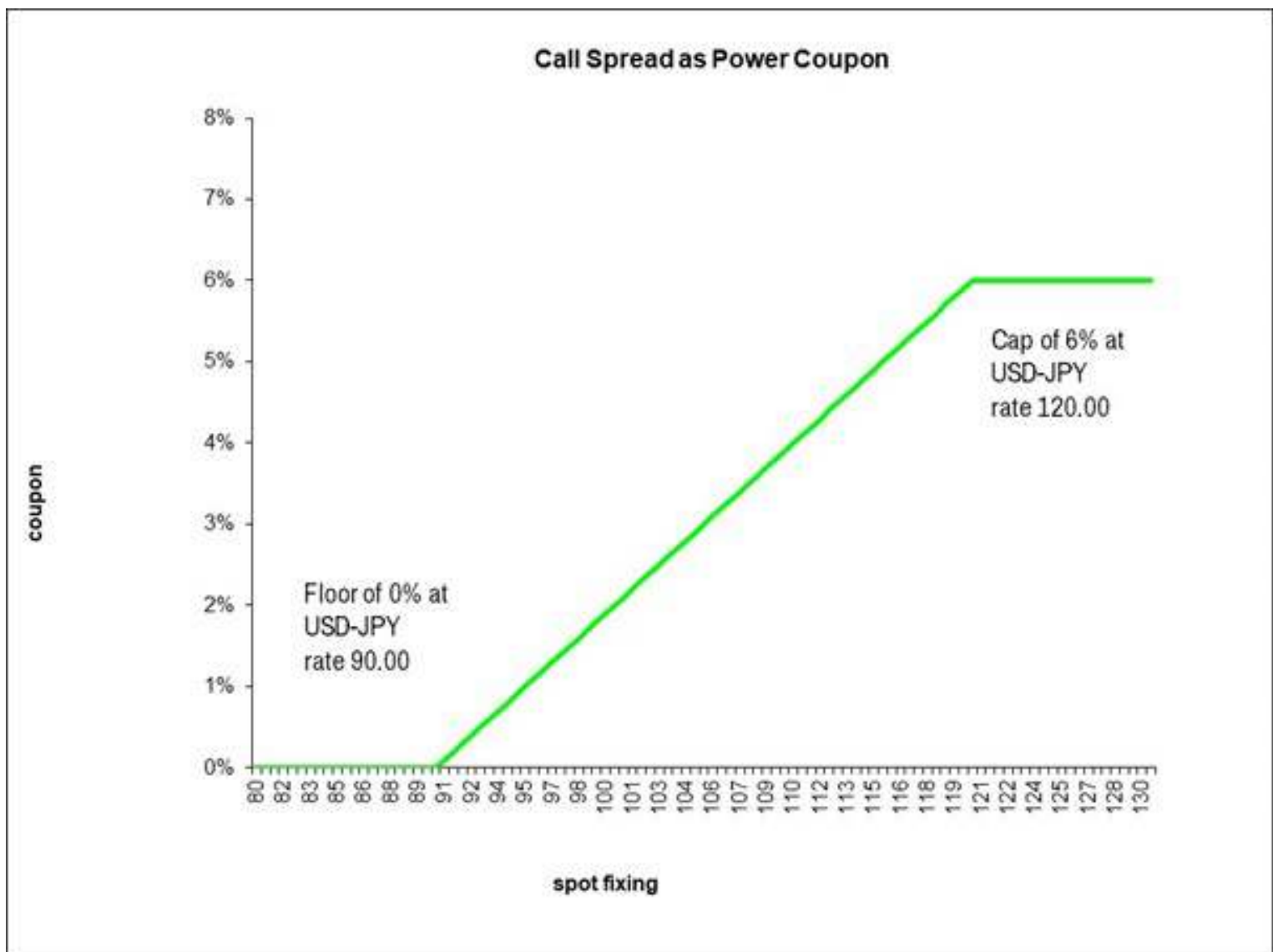


Figure 5: PRDC Power Coupon Constructed with a USD-JPY Call Spread Paying Minimum 0% and Maximum 6%.

The main reasons why a PRDC with a power coupon is considered attractive by the buy-side are that the first coupon(s) is (are) typically guaranteed, and that the buy-side receives high coupons if USD-JPY does not decrease, i.e., if JPY does not strengthen. In the first decade of 2000 USD interest rates were higher than JPY interest rates, whence the USD-JPY forward curve is in backwardation. The buy-side taking a view in USD-JPY not going backwards is essentially a carry trade, 90% of all trade ideas. Furthermore, the buy-side investor receives USD coupons, for which she would receive more JPY as the forward curve indicates.

The hidden carry trade is: The FX forward, i.e. the average of the future spot is very low for long term coupons, wo the call spread is really cheap. The investor's expectation of the future FX spot is that the spot moves up, so the 6% coupon is considered safe.

The principle of the cash flows of a Power Reverse Dual are illustrated in [Figure 6](#).

Power Reverse Dual Cash Flows

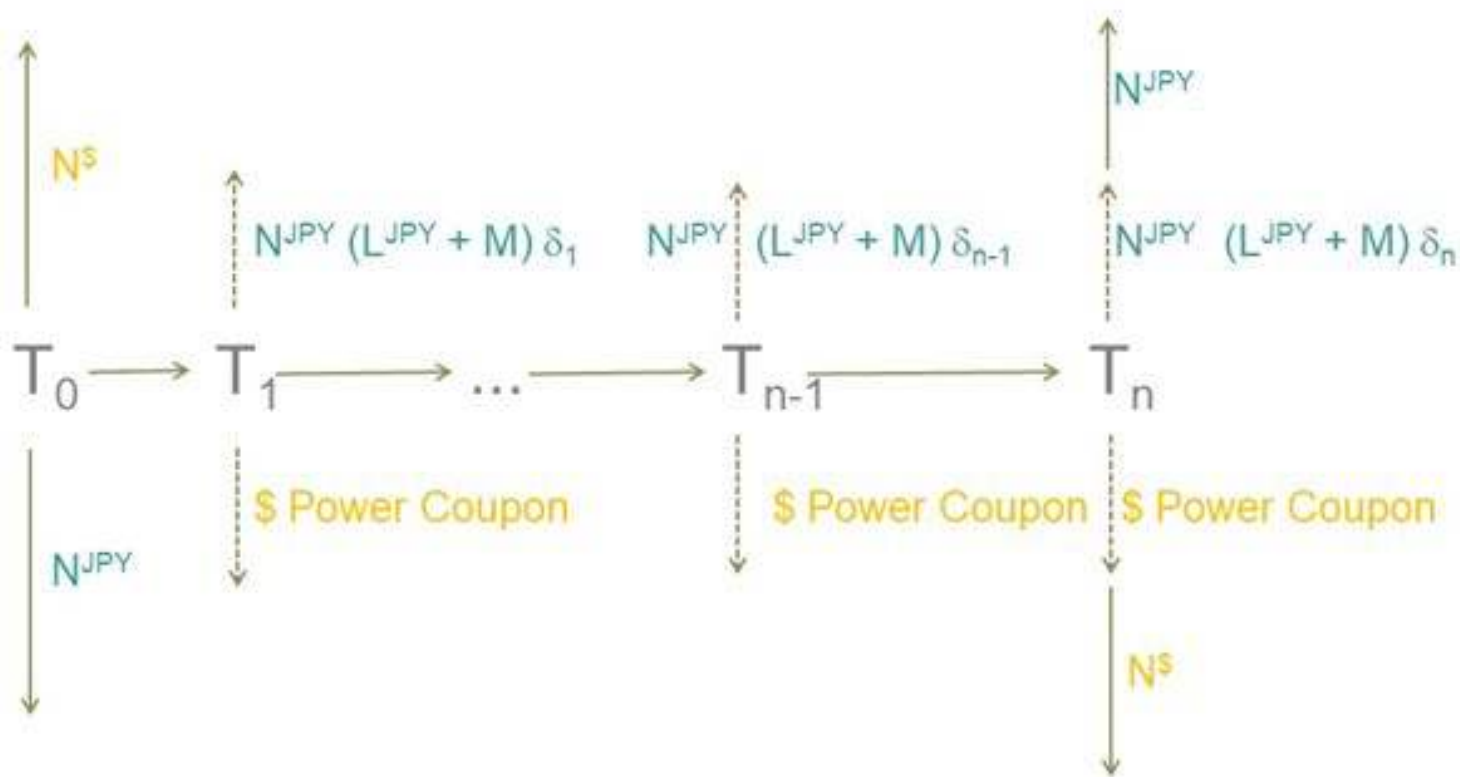


Figure 6: PRDC Cash Flows.

Soon after the principal idea of a power coupon had spread the greed-driven path to even higher coupons took its natural course. One way is to make the Power Reverse Dual Callable by the issuing bank, typically Bermudan style with a right to call on the coupon dates. However, since it is very difficult to predict for the buy-side when the bank is likely to call the bond, a more transparent early termination based on an FX spot hitting a pre-specified barrier as introduced. This feature is referred to as auto-callable. Needless to mention that multiple coupons, auto-callability, and Bermudan callability can and have been combined. To pick up an even higher carry effect, one can also structure a PRCD with USD funding and power coupons depending on AUD/JPY. AUD/JPY is known to be the carry trade currency Japanese housewives have applied, commonly and generally referred to as Mrs. Watanabe.

Hedging of PRDCs

Let me make a few comments on the hedging of PRDCs. We consider the simple variant with the power coupon following a call spread in USD-JPY as above. The sell-side would be mainly concerned with the FX options embedded in the power coupon, i.e. hedging the short vega of the lower strike option and the long vega of the higher strike option. The vega position of the short call spread (sell-side view) is illustrated in [Figure 7](#).

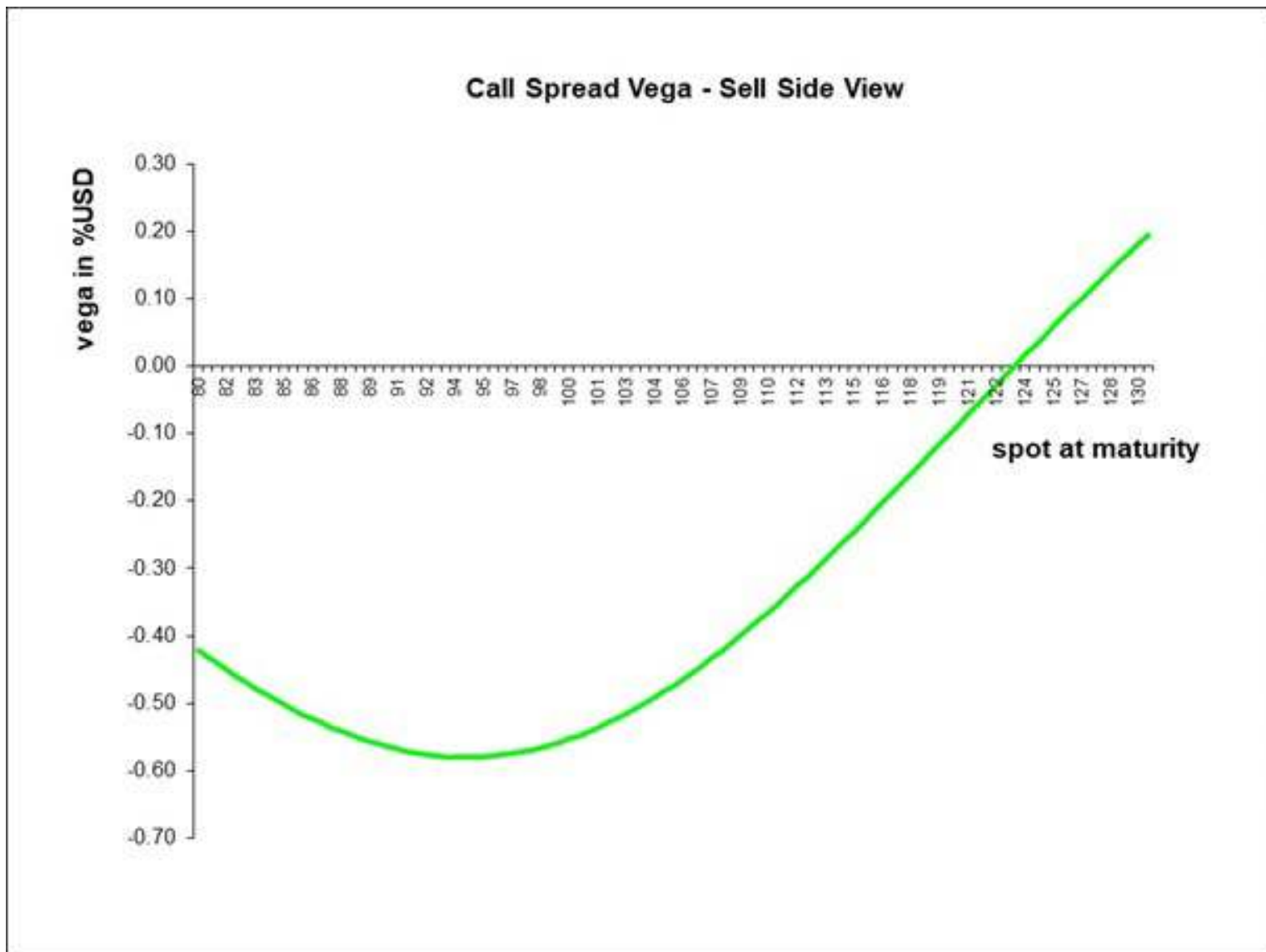


Figure 7: Sell-Side Vega of a PRDC Power Coupon via a 10-Year USD-JPY Call Spread.

In Japan, many of these types of PRDCs traded in the 90s and the first decade, and obviously, the banks were only sellers and pension funds the buyers. Consequently, practically all market participants on the sell-side had the similar positions and since the sell-side typically hedges market risk of their derivatives portfolios, they would all be short FX vega for lower strikes and long maturities and needed to compensate this by going long vega for lower strikes in USD-JPY.

In Short: If USD-JPY spot goes down, the sell-side needs to buy Options.

This implied a heavy skew in USD-JPY for many years, merely driven by supply and demand, especially, because long term FX vega is illiquid and therefore bid-offer spreads wide. Risk Reversals were strongly negative, a market phenomenon, which did not indicate that spot would go down. However, when JPY strengthened, and USD weakened in the second decade, and many of the PRDCs were called or auto-called, the vega positions were unwound and the USD-JPY smile changed its pattern to a risk reversal closer to zero, see the year 2015 in Figure 1. Moreover, the hedging situation also suffered from significant cross

effects because FX vega moves as the FX forward moves and the FX forward moves are driven by the changes in FX spot, interest rates and their correlation.

Conclusion

1. Vega hedging a large pool of existing PRDCs with USD-JPY power coupons contributes substantially to USD-JPY smiles being down-skewed.
2. The pattern changes when many PRDCs terminate (expire or auto-call) and vega hedges are unwound.
3. 90% of all trades are carry-trades, and quite often these carry trades are embedded in structured products.

References

- Wystup: FX Options and Structured Products, Second Edition, Wiley 2017.
- Wystup: **Why are USD-JPY Risk Reversals always negative?** Wilmott, July 2024

WE WANT TO



HEAR FROM YOU

Do you have suggestions, questions or comments? Then contact us at: info@mathfinance.com

We look forward to your feedback!

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December 19th, 2024

Mathfinance AG

Kaiserstraße 50, 60329, Frankfurt am Main

info@mathfinance.com

www.mathfinance.com

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